Next-Generation Mission Control Center Voice System: Extended Voice System

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Voice communication in the Mission Control Center (MCC) traditionally used physical keysets as the user interface. Controllers and engineers use the keysets to select "meet-me" conferences over which they communicate. Typically, more than one conference is selected simultaneously. The system "sums" the conferences and the audio sounds as if it were a single source.

In the late 1990s, the MCC voice keyset system was externalized to computer networks so that engineers located in office areas could monitor selected voice conferences using a custom software program installed on personal computers. A decade later, the components of the monitor-only system—or "MCC Audio"—were essentially obsolete. Concurrently, the Mission Evaluation Room engineering group and several operations groups at Johnson Space Center desired full office-based remote operations capability, where remote operations meant two-way selectable intercom communications outside the MCC. The keyset became an obvious impediment to implementation, unless the "keyset" were to become software on a personal computer. Requirements for the traditional fixed-location keyset-centric system, based on 30+ years experience in command and control operations, did not incorporate the lessons learned during the decade-long operation of the MCC Audio System, since that system was not an integrated part of the MCC Voice System.

A requirements synthesis effort captured the lessons learned. These requirements then became an integral part of the Extended Voice System (i.e., Evoice) requirements. At a summary level, the requirements can be rolled up to a table:

Evoice should provide communication for users located at any combination of the following locations: offices, off-site contractor facilities, and/or arbitrary off-site locations.
Evoice shall integrate, at reasonable cost, with the traditional, fixed location, high performance, core MCC voice system.
Evoice shall offer the user two modes of operation. In the primary mode of operation, Internet Protocol based networks shall be the primary transmission media for both audio and operator control commands.
In the backup mode of operation the system shall allow autonomous use of the world phone system as an audio transmission and receive device
Internet Protocol based communications shall be encrypted. Default encryption provides a reasonable assurance of confidentiality.
Evoice shall enable communication latency of less than 200 milliseconds independent of transmission media. Industry standard documents indicate that acceptable conversational dynamics begin to degrade if delays exceed 200 ms
Evoice shall offer the same basic functionality as the traditional core mission control center voice system.
Evoice should use connection oriented TCP/IP protocols for audio and control transport.
Evoice shall authenticate users against identities maintained within existing infrastructure. .
Access to conferences shall be controlled on a per user, per conference basis. Evoice should interface with a third party business process management tool to enable management of these permissions.
Evoice shall provide expandibility for later addition of recording devices.

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Based on these requirements, parametric cost models were developed when assessing Evoice design options. Figure 1 shows cost profiles associated with an off-the-shelf hardware-based Voice over Internet Protocol (VoIP system) (Option A), an off-the-shelf software-based and feature-rich VoIP system (Option B), and a less-mature off-the-shelf software-based VoIP system (Option C). Average per-user costs in software-based systems decrease with user count because no additional physical elements are added to the system. The selection has an obvious dependency on the number of simultaneous users in both the deployment costs and the total cost of ownership, or life-cycle cost.

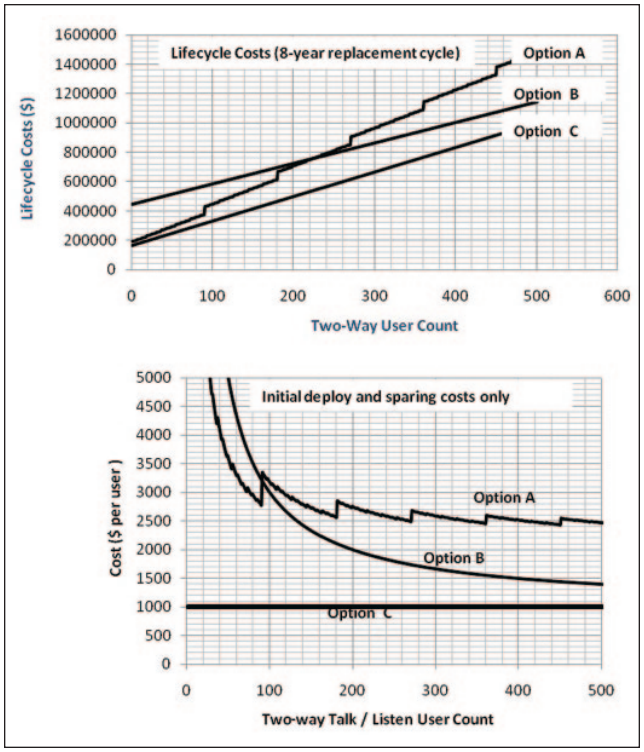

Fig. 1. *Cost estimates.*

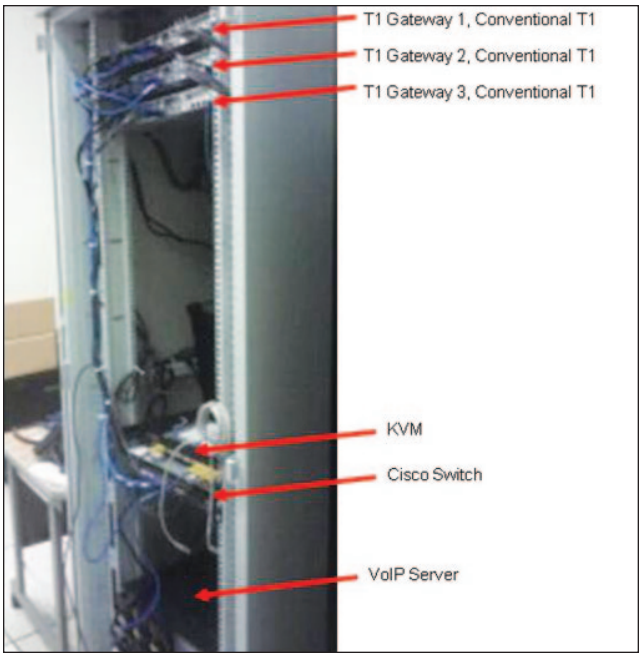

Fig. 2. *System deployment.*

Option B was selected to satisfy the Extended Voice System requirements. The Quintron DICES VoIP system was selected for deployment in the MCC for the reasons already mentioned, but also due to its synergy with the VoIP deployment at Marshall Space Flight Center. Future plans for VoIP site contingency operations, leveraging the analogous assets between Marshall Space Flight Center and Johnson Space Center, are forthcoming.

As configured, the Johnson Space Center system can support over 300 simultaneous users. The configuration, complete with support gear, is shown in figure 2.

The significance of this system is its ability to deliver two-way voice communications to flight controllers and engineers, wherever they are located. This is a significant enabling step toward the goal of providing lower cost, flexible mission support infrastructure for missions of today and the future.